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EXAMINER	
TORRES, JOSEPH D	
ART UNIT	**PAPER NUMBER**
2133	8

DATE MAILED: 05/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/882,283	CHEN ET AL.	
	Examiner	Art Unit	
	Joseph D. Torres	2133	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 April 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) *1* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 June 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group II, claims 2-32, in Paper No. 7 is acknowledged.

Claim 1 is withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Election was made **without** traverse in Paper No. 7.

This application contains claim 1 drawn to an invention nonelected without traverse in Paper No. 7. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: '20' in Figure 1. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 2-32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 2, 15 and 29-32 recite, "closed set of symbols". Nowhere in the Application does the Applicant provide an adequate definition of "closed set of symbols" to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 2, 15 and 29-32 recite, "base closed set of symbols". Nowhere in the Application does the Applicant provide an adequate definition of "base closed set of symbols" to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 3-14 depend from claim 2, hence inherit the deficiencies in claim 2.

Claims 16-28 depend from claim 15, hence inherit the deficiencies in claim 15.

Claims 5-10 and 18-23 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to

which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 5, 6, 18 and 19 recite, "residual state information". Nowhere in the Application does the Applicant provide an adequate definition of "residual state information" to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 7 and 9 depend from claim 5, hence inherit the deficiencies in claim 5.

Claims 8 and 10 depend from claim 6, hence inherit the deficiencies in claim 6.

Claims 20 and 22 depend from claim 18, hence inherit the deficiencies in claim 18.

Claims 21 and 23 depend from claim 19, hence inherit the deficiencies in claim 19.

Claim Rejections - 35 USC § 102

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 2, 4-15, 17-30 are rejected under 35 U.S.C. 102(e) as being anticipated by Cheng; Jung-Fu (US 6658071 B1).

35 U.S.C. 102(e) rejection of claims 2, 15, 29 and 30.

In a digital information processing system wherein a model of a finite state machine FSM receiving a plurality of FSM inputs (the Abstract and col. 4, lines 65-67 in Cheng teach that Convolutional decoder 52 in Figure 5 of Cheng for receiving a plurality of received convolutionally coded inputs is based on a Delayed-Decision-Feedback Log-

MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis; Note: a convolutional encoder is a FSM, hence convolutionally coded inputs are FSM inputs and circuitry for producing decoded data by producing forward and Backward metrics for a reduced state trellis as the reduced state trellis is traversed in the forward and backward directions is substantially a model of an FSM) and producing a plurality of FSM outputs is represented by a reduced-state trellis (Convolutional decoder 52 in Figure 5 of Cheng which is based on a generalized BCJR paradigm for a reduced state trellis produces a plurality of FSM outputs represented by a reduced-state trellis) and wherein said FSM inputs are defined on a base closed set of symbols (the symbols d_k in Figure 5 are derive from a finite field and any finite field is a closed set), a method for updating soft decision information on said FSM inputs into higher confidence information, the method comprising: inputting said soft decision information in a first index set (col. 9, lines 9-11 in Cheng teach that $V(C_m)$ is a priori log-likelihood soft decision information input for Convolutional decoder 52 in Figure 5 of Cheng; Note: $V(C_m)$ is an indexed set and is soft input for Convolutional decoder 52); processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward transition metrics (Steps 66-72 in Figure 6 of Cheng are steps for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating forward state metrics, hence are forward transition metrics); processing a backward recursion on said input soft decision information based on said reduced-state

trellis representation to produce backward state metrics and backward transition metrics, wherein said backward recursion is independent of said forward recursion (Steps 74-80 in Figure 6 of Cheng are steps for processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating backward state metrics, hence are backward transition metrics; Note: Steps 66-72 and Steps 74-80 in Figure 6 of Cheng are performed independently of each other, hence backward recursion is independent of said forward recursion); operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information (Step 78 in Figure 6 of Cheng produces higher confidence extrinsic information, $w(c_{nb})$ in equation 41 in col. 13); and outputting said higher confidence information (Steps 74-80 in Figure 6 of Cheng teach that when iteration are completed, the final higher confidence extrinsic information $w(c_{nb})$ is the final output for the generalized BCJR algorithm for reduced state trellises, hence Steps 66-80 in Figure 6 of Cheng are steps for operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information).

35 U.S.C. 102(e) rejection of claims 4 and 17.

Equations 25 and 26 in col. 10 of Cheng teach said operating comprises at least one of the following operations: summing, multiplication, minimum, maximum, minimum*, maximum*, linear weighting and exponentiation.

35 U.S.C. 102(e) rejection of claims 5 and 18.

γ_n in equations 6 and 7 in col. 7 of Cheng is "residual state information". Equation 9 in col. 7 of Cheng teaches using residual state information to augment reduced-state trellis information to produce said forward state metrics. Steps 66-72 in Figure 6 of Cheng teach that "residual state information" is updated on each iteration since γ_n in equations 6 and 7 in col. 7 of Cheng varies as the trellis is traversed during the calculation of forward metrics.

35 U.S.C. 102(e) rejection of claims 6 and 19.

γ_n in equations 6 and 7 in col. 7 of Cheng is "residual state information". Equation 9 in col. 7 of Cheng teaches using residual state information to augment reduced-state trellis information to produce said backward state metrics. Steps 74-80 in Figure 6 of Cheng teach that "residual state information" is updated on each iteration since γ_n in equations 6 and 7 in col. 7 of Cheng varies as the trellis is traversed during the calculation of backward metrics.

35 U.S.C. 102(e) rejection of claims 7, 8, 20 and 21.

The variables S_n equations 6 and 7 in col. 7 of Cheng correspond to states of an FSM, hence "residual state information" γ_n is a plurality of decisions on said FSM inputs.

35 U.S.C. 102(e) rejection of claims 9, 10, 22 and 23.

The variables S_n equations 6 and 7 in col. 7 of Cheng correspond to states of a symbol at time = i and j, hence the closed set of symbols used in the calculation of the "residual state information" γ_n is revised each time the "residual state information" γ_n is updated. Note: i and j determine the partition of symbols used in the calculation.

35 U.S.C. 102(e) rejection of claims 11, 24 and 28.

Col. 10, lines 50-58, Cheng suggest the use of the Log-MAP module taught in Cheng for use in an Iterative SISO decoder for Turbo codes.

35 U.S.C. 102(e) rejection of claims 12 and 25.

A convolutional code is substantially a model for partial response channels in a communication medium or a storage medium, hence said finite state machine is operative to model at least one of the following: a communication medium; a storage medium; and an imaging medium.

35 U.S.C. 102(e) rejection of claims 13 and 26.

A trellis is a model of a convolutional encoder which is a forward error correction encoder.

35 U.S.C. 102(e) rejection of claims 14 and 27.

See U_n in Figure 5 of Cheng. U_n is composed of desired signal x_n and a multi-path fading interference signal.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 3 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cheng; Jung-Fu (US 6658071 B1) in view of Crozier; Stewart et al. (US 6145114 A, hereafter referred to as).

35 U.S.C. 103(a) rejection of claims 3 and 16.

Cheng substantially teaches the claimed invention described in claim 2 (as rejected above).

However Cheng does not explicitly teach the specific use of iterative SISO decoding using the Log-MAP algorithm.

Crozier, in an analogous art, teaches iterative SISO decoding using the Log-MAP algorithm (see Fig. 1 in Crozier; Note: log-APP is used synonymously with Log-MAP). The Examiner asserts that Cheng substantially teaches the inner operation of the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis (Abstract and col. 4, lines 65-67 in Cheng) and clearly suggest its use in an Iterative SISO decoders for Turbo codes (col. 10, lines 50-58, Cheng), however does not teach the operation of the iterative SISO decoder. Crozier on the other hand teaches and iterative SISO decoder (See Figure 1 in Crozier). In addition, Crozier teaches that feedback is used to modify input soft decision information L using said output higher confidence information L_{out}. Note: iterations are continued until a final decision is made. Hence one of ordinary skill in the art at the time the invention was made would have been highly motivated by the suggestion in the Cheng patent to modify the teachings in the Cheng patent by including it in an iterative SISO decoder in order to implement a SISO decoder.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng with the teachings of Crozier by including use of iterative SISO decoding using the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis as taught in the Cheng patent. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made, because one of ordinary skill in the art would have recognized that use of iterative SISO decoding using the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis as taught in the Cheng patent would

have provided the opportunity to implement a SISO decoder suggested by Cheng (col. 10, lines 50-58, Cheng).

6. Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cheng; Jung-Fu (US 6658071 B1) in view of Benedetto et al. (S. Benedetto, G. Montorsi, D. Divsalar and F. Pollara in "Soft-Output Decoding Algorithms in Iterative Decoding of Turbo Codes," The Telecommuinications and Data Acquisition Progress Report, Jet Propulsion Laboratory, California Institute of Technology, vol. 42-124, pp. 63-87, February 1996).

35 U.S.C. 103(a) rejection of claims 31 and 32.

In a digital information processing system wherein a model of a finite state machine FSM receiving a plurality of FSM inputs (the Abstract and col. 4, lines 65-67 in Cheng teach that Convolutional decoder 52 in Figure 5 of Cheng for receiving a plurality of received convolutionally coded inputs is based on a Delayed-Decision-Feedback Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis; Note: a convolutional encoder is a FSM, hence convolutionally coded inputs are FSM inputs and circuitry for producing decoded data by producing forward and Backward metrics for a reduced state trellis as the reduced state trellis is traversed in the forward and backward directions is substantially a model of an FSM) and producing a plurality of FSM outputs is represented by a reduced-state trellis (Convolutional decoder 52 in Figure 5 of Cheng which is based on a generalized BCJR paradigm for a

reduced state trellis produces a plurality of FSM outputs represented by a reduced-state trellis) and wherein said FSM inputs are defined on a base closed set of symbols (the symbols d_k in Figure 5 are derive from a finite field and any finite field is a closed set), a method for updating soft decision information on said FSM inputs into higher confidence information, the method comprising: inputting said soft decision information in a first index set (col. 9, lines 9-11 in Cheng teach that $V(C_m)$ is a priori log-likelihood soft decision information input for Convolutional decoder 52 in Figure 5 of Cheng; Note: $V(C_m)$ is an indexed set and is soft input for Convolutional decoder 52); processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward transition metrics (Steps 66-72 in Figure 6 of Cheng are steps for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating forward state metrics, hence are forward transition metrics); processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward transition metrics, wherein said backward recursion is independent of said forward recursion (Steps 74-80 in Figure 6 of Cheng are steps for processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics; branch metrics in col.8, lines 55-65 in Cheng are used for calculating backward state metrics, hence are backward transition metrics; Note: Steps 66-72 and Steps 74-80 in Figure 6 of Cheng are performed independently of each

other, hence backward recursion is independent of said forward recursion); operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information (Step 78 in Figure 6 of Cheng produces higher confidence extrinsic information, $w(c_{nb})$ in equation 41 in col. 13); and outputting said higher confidence information (Steps 74-80 in Figure 6 of Cheng teach that when iteration are completed, the final higher confidence extrinsic information $w(c_{nb})$ is the final output for the generalized BCJR algorithm for reduced state trellises, hence Steps 66-80 in Figure 6 of Cheng are steps for operating on said forward state metrics, forward transition metrics, backward transition metrics and said backward state metrics to produce said higher confidence information).

However Cheng does not explicitly teach the specific use of specific hardware for implementing the device taught in the Cheng patent.

Benedetto et al. (hereafter referred to as Benedetto), in an analogous art, teaches a plurality of device inputs for inputting said soft decision information in a first index set (Figure 6 in Benedetto provides a plurality of device inputs for inputting said soft decision information in a first index set); a plurality of processing units for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward state transition metrics, processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward state transition metrics, wherein said backward recursion is independent of said forward recursion, and operating on said forward state metrics, said forward state

transition metrics, said backward state metrics and said backward state transition metrics to produce said higher confidence information (Figure 6 in Benedetto provides a plurality of a plurality of processing units for processing a forward recursion on said input soft decision information based on said reduced-state trellis representation to produce forward state metrics and forward state transition metrics, processing a backward recursion on said input soft decision information based on said reduced-state trellis representation to produce backward state metrics and backward state transition metrics, wherein said backward recursion is independent of said forward recursion, and operating on said forward state metrics, said forward state transition metrics, said backward state metrics and said backward state transition metrics to produce said higher confidence information); and a plurality of device outputs for outputting said higher confidence information (Figure 6 in Benedetto provides a plurality of device outputs for outputting said higher confidence information). The Examiner asserts that Cheng substantially teaches the inner operation of the Log-MAP algorithm, which generalizes the traditional BCJR paradigm to a reduced state trellis (Abstract and col. 4, lines 65-67 in Cheng) and explicitly suggests its use in the Iterative SISO decoders for Turbo codes taught in Benedetto (col. 10, lines 50-58, Cheng).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Cheng with the teachings of Benedetto by including use of specific hardware for implementing the device taught in the Cheng patent. This modification would have been obvious to one of ordinary skill in the art, at the time the invention was made, because one of ordinary skill in the art would have recognized that

use of specific hardware for implementing the device taught in the Cheng patent would have provided the opportunity to implement the suggested decoder in Chang according to Chang's suggesting that it be implemented in the SISO decoders of Benedetto (col. 10, lines 50-58, Cheng).

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Muller, S.H.; Gerstacker, W.H.; Huber, J.B.; Reduced-state soft-output trellis-equalization incorporating soft feedback, GLOBECOM '96, Volume: 1, 18-22 Nov. 1996.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph D. Torres whose telephone number is (703) 308-7066. The examiner can normally be reached on M-F 8-5.
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Albert Decady can be reached on (703) 305-9595. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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